

What is claimed is:

1      1. A transmission apparatus for use in a communication network to  
2 which a plurality of transmission equipment are connected through a plurality of  
3 transmission lines transmitting synchronous multiplex signals, wherein overhead for  
4 supervision, maintenance and operations of transmission equipment and transmission  
5 lines is added to a payload in which main signals are multiplexed, said transmission  
6 apparatus comprising:

7                an optical transmitter that transmits said synchronous multiplex signals to  
8 said transmission lines,

9                an optical receiver that receives said synchronous multiplex signals from  
10 said transmission lines,

11               an overhead processing unit that adds said overhead to said payload and  
12 extracts said overhead out of said synchronous multiplex signals from said optical  
13 receiver,

14               a cross connect unit that divides and multiplexes said payload inputted  
15 from said overhead processing unit, switches output routes of said payload for  
16 transmission to either of said transmission lines, and outputs to the overhead processing  
17 unit again,

18               a clock unit that supplies a clock to at least said cross connect unit,

19               an equipment supervision unit that supervises at least said cross connect  
20 unit and said clock unit and outputs an instruction signal based upon the result of the  
21 supervision,

22               a switching control unit that controls switching of the transmission lines so  
23 that, being based upon said instruction signal and said overhead, said cross connect unit,  
24 said overhead processing unit and said optical transmitter, said synchronous multiplex  
25 signals may be transmitted to either of said transmission lines properly; and wherein

26               upon said equipment supervising unit detecting a condition in which  
27 obstacles have occurred in more than one group in at least either of said cross connect  
28 unit and said clock unit, said equipment supervision unit inserts information about said  
29 obstacles in said instruction signal, and said switching control unit into which said  
30 instruction signal is inputted enables said overhead processing unit and the optical  
31 transmitter to output isolation instruction information to said transmission line.

1           2. A transmission apparatus according to claim 1, said transmission  
2 apparatus and an adjacent transmission equipment being interconnected by two optical  
3 fibers; wherein the capacity of each line is divided into two, one half thereof being used  
4 as a working line and the remaining half thereof being used as a protection line; and  
5 wherein, upon occurrence of said obstacle, said isolation instruction information further  
6 comprising said overhead indicating that said synchronous multiplex signals to be  
7 received are both in a signal obstacle condition.

1           3. A transmission apparatus according to claim 1, said transmission  
2 apparatus and an adjacent transmission equipment being interconnected by four optical  
3 fibers, each being used as a working line or a protection line; and wherein, upon  
4 occurrence of said obstacle, said isolation instruction information further comprising said  
5 overhead indicating that said synchronous multiplex signals to be received are both in a  
6 signal obstacle condition.

1           4. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 two optical fibers; wherein the capacity of each line is divided into two, one half thereof  
4 being used as a working line and the remaining half thereof being used as a protection  
5 line; and wherein, upon occurrence of said obstacle, said isolation instruction information  
6 further comprising said overhead for instructing a ring switch transmitting, upon  
7 reception, the received synchronous multiplex signals.

1           5. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 four optical fibers, each being used as a working line or a protection line; and wherein,  
4 upon occurrence of said obstacle, said isolation instruction information further  
5 comprising said overhead for instructing a ring switch transmitting, upon reception, the  
6 received synchronous multiplex signals.

1           6. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 two optical fibers; wherein the capacity of each line is divided into two, one half thereof  
4 being used as a working line and the remaining half thereof being used as a protection

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5 line; and wherein, upon occurrence of said obstacle, said isolation instruction information  
6 further comprising said overhead indicating that said synchronous multiplex signals to be  
7 transmitted are in a signal obstacle condition.

1           7. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 four optical fibers, each being used as a working line or a protection line; and wherein,  
4 upon occurrence of said obstacle, said isolation instruction information further  
5 comprising said overhead indicating that said synchronous multiplex signals to be  
6 transmitted are in a signal obstacle condition.

1           8. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 two optical fibers; wherein the capacity of each line is divided into two, one half thereof  
4 being used as a working line and the remaining half thereof being used as a protection  
5 line, or the transmission equipment are interconnected by four optical fibers, each being  
6 used as a working line or a protection line; and wherein, upon occurrence of said obstacle,  
7 said isolation instruction information further comprising a no-signal condition caused by  
8 stopping the transmission of said optical transmitter.

1           9. A transmission apparatus for a network according to claim 1, said  
2 transmission apparatus and an adjacent transmission equipment being interconnected by  
3 four optical fibers, each being used as a working line or a protection line; and wherein,  
4 upon occurrence of said obstacle, said isolation instruction information further  
5 comprising a no-signal condition caused by stopping the transmission of said optical  
6 transmitter.

1           10. A transmission apparatus for a network according to claim 1,  
2 wherein said transmission apparatus, upon occurrence of said obstacle, prepares as said  
3 isolation instruction any of the following:

4           said isolation instruction information is said overhead, wherein said  
5 overhead indicates that said received synchronous multiplex signals are both in signal  
6 obstacle conditions,

7               said isolation instruction information is said overhead, wherein said  
8 overhead instructs a ring switch, in which synchronous multiplex signals are transmitted  
9 upon reception,

10               said isolation instruction information is said overhead, wherein said  
11 overhead indicates that said synchronous multiplex signals to be transmitted are in a  
12 signal obstacle condition, and

13               said isolation instruction information is a no output signal condition caused  
14 by stopping the transmission of said optical transmitter.

1               11. A telecommunication network transmission system, said network  
2 transmission system having a plurality of transmission apparatuses, each of said plurality  
3 of transmission apparatus operative to transmit synchronous multiplex signals, wherein in  
4 said transmission apparatus, an overhead for supervision, maintenance and operations of  
5 transmission apparatuses and transmission lines is added to payload in which main signals  
6 are multiplexed, said transmission apparatus comprising:

7               a plurality of optical transmitters,

8               a plurality of optical receivers,

9               a cross connect unit that divides and multiplexes said payload input  
10 received from at least one of said plurality of optical receivers, and thereupon switches  
11 output to any of said plurality of transmission apparatuses,

12               a clock unit that supplies a clock signal to at least said cross connect unit,  
13               an equipment supervision unit that supervises at least said cross connect  
14 unit and said clock unit;

15               wherein responsive to detection of a condition in which obstacles have  
16 occurred in more than one group, in at least one of said plurality of transmission  
17 apparatuses, said equipment supervision unit creates optical transmitter output isolation  
18 instruction information in order to isolate said transmission apparatus in which obstacles  
19 have occurred in more than one group, from said network.

1               12. A telecommunication system according to claim 11, wherein said  
2 isolation instruction information further comprises said overhead, and wherein said  
3 overhead indicates that said synchronous multiplex signals to be received are in a signal  
4 obstacle condition.

1           13. A telecommunication system according to claim 11, wherein said  
2 isolation instruction information further comprises said overhead, and wherein said  
3 overhead instructs a ring switch to transmit, upon reception, received synchronous  
4 multiplex signals.

1           14. A telecommunication system according to claim 11, wherein said  
2 isolation instruction information further comprises said overhead, and wherein said  
3 overhead indicates that said synchronous multiplex signals to be transmitted are in a  
4 signal obstacle condition.

1           15. A telecommunication system according to claim 11, wherein said  
2 isolation instruction information further comprises an indication of a no signal condition  
3 caused by stopping the transmission of said optical transmitter.

1           16. A telecommunication system according to claim 11, wherein said  
2 transmission apparatus, upon occurrence of said obstacle, prepares as said isolation  
3 instruction any of the following:

4           said isolation instruction information is said overhead indicating that said  
5 received synchronous multiplex signals are both in signal obstacle conditions,

6           said isolation instruction information is said overhead instructing a ring  
7 switch, in which synchronous multiplex signals are transmitted upon reception,

8           said isolation instruction information is overhead indicating that said  
9 synchronous multiplex signals to be transmitted are in a signal obstacle condition, and

10          said isolation instruction/information is a no output signal condition caused  
11 by stopping the transmission of said optical transmitter.

1           17. A network transmission system, comprising:  
2           a plurality of nodes, wherein upon a fault condition in which obstacles  
3 have occurred in more than one group in at least one of said plurality of nodes, said node  
4 suffering said fault condition isolates itself from others of said plurality of nodes in said  
5 network transmission system.

1           18. An network transmission system according to claim 17, said  
2 network transmission system having a plurality of nodes, wherein each of said plurality  
3 nodes is operative to transmit synchronous multiplex signals, wherein in said nodes, an

4 overhead for supervision, maintenance and operations of nodes and transmission lines is  
5 added to payload in which main signals are multiplexed, each of said nodes comprising:  
6           a plurality of optical transmitters,  
7           a plurality of optical receivers,  
8           a cross connect unit that divides and multiplexes said payload input  
9 received from at least one of said plurality of optical receivers, and thereupon switches  
10 output to any of said plurality of nodes,  
11           a clock unit that supplies a clock signal to at least said cross connect unit,  
12           an equipment supervision unit that supervises at least said cross connect  
13 unit and said clock unit;  
14           wherein responsive to detection of a condition in which obstacles have  
15 occurred in more than one group, in at least one of said plurality of nodes, said equipment  
16 supervision unit creates optical transmitter output isolation instruction information in  
17 order to isolate said nodes in which obstacles have occurred in more than one group, from  
18 said network.

1           19. An network transmission system according to claim 17, wherein  
2 said isolation instruction information further comprises said overhead indicating that said  
3 synchronous multiplex signals to be received are in a signal obstacle condition.

1           20. An network transmission system according to claim 17, wherein  
2 said isolation instruction information further comprises said overhead instructing a ring  
3 switch transmitting, upon reception, the received synchronous multiplex signals.

1           21. An network transmission system according to claim 17, wherein  
2 said isolation instruction information further comprises said overhead indicating that said  
3 synchronous multiplex signals to be transmitted are in a signal obstacle condition.

1           22. An network transmission system according to claim 17, wherein  
2 said isolation instruction information further comprises in no signal condition caused by  
3 stopping the transmission of said optical transmitter.

1           23. An network transmission system according to claim 17, wherein  
2 said node, upon occurrence of said obstacle, prepares as said isolation instruction any of  
3 the following:

4               said isolation instruction information is said overhead indicating that said  
5 received synchronous multiplex signals are both in signal obstacle conditions,  
6               said isolation instruction information is said overhead instructing a ring  
7 switch, in which synchronous multiplex signals are transmitted upon reception,  
8               said isolation instruction information is overhead indicating that said  
9 synchronous multiplex signals to be transmitted are in a signal obstacle condition, and  
10              said isolation instruction information is a no output signal condition caused  
11 by stopping the transmission of said optical transmitter.

1               24. A method for recovering from a plurality of substantially  
2 contemporaneous faults in a network node, said network node capable of transmitting  
3 information as synchronous multiplex signals via a plurality of transmission lines,  
4 including a first one and a second one, said method comprising:

5               preparing isolation information into an instruction signal according to said  
6 plurality of substantially contemporaneous faults;

7               providing said isolation information to at least one of a plurality of  
8 adjacent network nodes; and

9               switching said transmission lines based upon said instruction signal so that  
10 said synchronous multiplex signals may be transmitted to either of said transmission lines  
11 properly.

1               25. The method of claim 24, wherein, upon occurrence of said plurality  
2 of substantially contemporaneous faults, said preparing said isolation information further  
3 comprises any of the following:

4               said isolation instruction information comprises an overhead that indicates  
5 that received synchronous multiplex signals are in signal obstacle conditions,

6               said isolation instruction information comprises an overhead that instructs  
7 a ring switch, in which synchronous multiplex signals are transmitted upon reception,

8               said isolation instruction comprises an overhead that indicates that  
9 synchronous multiplex signals to be transmitted are in a signal obstacle condition, and

10              said isolation instruction information comprises a no output signal  
11 condition caused by stopping transmission of an optical transmitter within said node.

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- 1                   26. The method of claim 24, wherein said network further comprises a
  - 2 SONET network.
  - 1                   27. The method of claim 26, wherein said SONET network is a 2 fiber
  - 2 BLSR network
  - 1                   28. The method of claim 26, wherein said SONET network is a 4 fiber
  - 2 BLSR network